

REMARKS

Claims 1, 3-12, 14, 15, 17-19 and 21-28 are pending in this application, claims 2, 13, 16, 20 and 29 having been cancelled by the above amendment. Of these claims, claims 1, 5, 6, 9 and 12 stand rejected under 35 USC §102(b) as being anticipated by Shenoy. Claims 4, 7, 8, 13, 21, 23-27 and 29 stand rejected under 35 USC §103(a) as being unpatentable over Shenoy. Claims 2, 14, 20 and 22 stand rejected under 35 USC §103(a) as being unpatentable over Shenoy in view of Chang et al. Claim 3 stands rejected under 35 USC §103(a) as being unpatentable over Shenoy in view of Fenton et al. Claims 14 and 16-18 stand rejected under 35 USC §103(a) as being unpatentable over Lau. Claim 15 stands rejected under 35 USC §103(a) as being unpatentable over Lau in view of Beigel. Claim 19 stands rejected under 35 USC §103(a) as being unpatentable over Lau in view of Heckaman et al. Claims 10, 11 and 28 stand rejected under 35 USC §103(a) as being unpatentable over Shenoy in view of Schildgen et al. Also, Claims 1, 10, 12-14, 16, 20, 21, 28 and 29 have been objected to for the reasons stated on page 2 of the Office Action.

In view of the preceding amendments and the following remarks, these rejections and objections are traversed, and reconsideration of this application is respectfully requested.

By the above amendment, Applicant has amended the claims to address the informalities identified by the Examiner. It is therefore respectfully requested that the objections to the claims be withdrawn.

Applicant's invention is a packaging assembly for an electronic device. The packaging assembly includes a base plate on which the electronic device is mounted and a ball grid array mounted to an opposite surface of the base plate from the electronic device. Signal vias extend through the base plate to interconnect the electronic device to the balls in the ball grid array. The packaging assembly has particular application for high speed electronic devices operating at frequencies up to 50 GHz where the packaging assembly significantly prevents parasitic capacitances and inductances that could affect device performance at these high speeds.

Each of Applicant's independent claims 1, 14 and 21 have been amended above to specifically state that the base plate is made of a laminate material including a fiber and resin mixture, and the base plate has a thickness less than 0.01". This material and the short length of the vias extending through the base plate provided by its minimal thickness help reduce the parasitic capacitances and inductances, especially at high frequencies, in combination with the ball grid array. Further, the independent claims have been amended above to specifically state that the packaging assembly allows the electronic device to effectively operate at frequencies from DC all the way up to 50 GHz. Applicant respectfully submits that the prior art of record, whether taken alone or in combination, fails to teach or suggest an electronic device packaging assembly having these features to allow the electronic device to operate at these high signal frequencies.

U.S. Patent No. 6,310,386 issued to Shenoy discloses a package for a semiconductor circuit that processes digital and RF signals, where the circuit has particular application for a cellular telephone circuit of the type shown in figure 6. Applicant submits that these types of cellular phone circuits do not operate at

frequencies anywhere near 50 GHz. It appears from column 8 that the frequency of the circuit is 2-4 GHz, and the resonant frequency of the inductors in the circuit is in the range of 9-18 GHz.

The Shenoy package includes a chip 310 formed on a substrate 402, where the chip 310 is connected to a ball grid array 314 by vias 408 extending through the substrate 402 (Figure 4a). Other embodiments of Shenoy show variations of this design. The substrate 402 is a plastic substrate (column 9, line 31), and other substrates disclosed by Shenoy may be made of other materials. However, what Shenoy fails to teach or suggest, as now more particularly claimed in Applicant's independent claims, is a combination of packaging elements that allow the electronic device to effectively operate at frequencies up to 50 GHz with minimal parasitic capacitive and inductive losses.

The elements of Applicants' claimed invention that help the electronic device operate at frequencies up to 50 GHz include a laminate substrate made of a fiber and resin mixture that has a thickness less than 0.01". It does not appear that Shenoy discloses the thickness of the substrate 402, but it is clear that it is not a fiber and resin laminate substrate having a thickness less than 0.01". Applicants' substrate in combination with a ball grid array allows the claimed packaging assembly to effectively operate at frequencies up to 50 GHz. Applicant submits that Shenoy does not teach this combination of elements for a circuit capable of operating at frequencies anywhere near 50 GHz. Therefore, Applicant submits that Shenoy cannot anticipate Applicant's independent claims.

U.S. Patent No. 6,075,710 issued to Lau discloses an electronic package 100 including an integrated circuit device 105 mounted on a substrate 110. Vias 125 extend through the substrate 110 and are in electrical contact with a land grid array (LGA) 130 that is electrically coupled to solder points 140 on a printed circuit board 150. The substrate 110 may be an FR-4/5 or BT substrate. The Examiner has stated that the substrate 110 is less than 0.01" thick, citing column 4, line 57, column 5, lines 11-61 and column 8, lines 8-11. Column 4, line 57-67 talks about the size of the solder bumps 115, column 5, lines 11-61 talks about the size of the solder pastes 140 and column 8, lines 8-11 states that the tape substrate 210 is under 4 mils. However, the tape substrate 210 is not the substrate 110 possibly being made of FR-4/5 or BT, but is a "single-layer" substrate. Further, Lau does not appear to state the FR-4/5 and BT are laminate substrates including a fiber and resin mixture.

Applicant submits that Lau does not teach or suggest a substrate on which an electronic device is mounted, where the substrate is made of a laminate material including a fiber and epoxy resin having a thickness less than 0.01", and where a ball grid array is mounted to an opposite side of the substrate from the electronic device to provide a packaging assembly that allows the electronic device to effectively operate at frequencies up to 50 GHz. Therefore, Applicant respectfully submits that Lau et al. cannot make Applicant's invention obvious as defined in amended independent claims 1, 14 and 21.

U.S. Patent No. 5,191,174 issued to Chang et al. discloses a multi-layered circuit board assembly 20 including a plurality of layers 21, 25 and 29. The layer assembly 20 includes a dielectric material 33, such as a material including an epoxy resin with glass

fibers. Column 5, lines 1-3 state that the sub-assembly 20 can have an overall thickness of 0.01".

Applicant submits that the layered sub-assembly 20 is not applicable for a packaging assembly including a single substrate where an electronic device is mounted to one surface of the substrate and a ball grid array is mounted to at an opposite surface of the substrate. Further, Applicant submits that Chang et al. does not teach or suggest such a substrate where the electronic device effectively operates at frequencies up to 50 GHz with minimal parasitic capacitive and inductive losses. Therefore, Applicant submits that Chang et al. does not provide the teaching missing from Shenoy that would make Applicant's claimed invention obvious as amended above.

U.S. Patent Applicant Publication 2002/0145475 to Fenton et al. discloses a dual conversion, noise resistant, digitally-controlled millimeter-wave frequency synthesizer. The synthesizer includes a resonator 80 that is buried within several layers, including a layer of Rogers 4003. Applicant submits that this teaching of Fenton et al. would not direct one of ordinary skill in the art to a packaging assembly for an electronic device that operates at frequencies up to 50 GHz, where the packaging assembly includes a Rogers 4003 substrate less than 0.01" thick to which the electronic device is mounted. Therefore, Applicant submits that Fenton et al. fails to provide the teaching missing from Shenoy to make Applicant's claimed invention obvious.

U.S. Patent Publication 2003/0169207 to Beigel discloses a microstrip antenna for an identification appliance, such as a wristband, bracelet, patch, headband, necklace, card, sticker, etc. Beigel discloses a low-cost printed circuit board material for operating in the UHF and SHF frequency bands, including Rogers 4003. However,

Beigel also fails to teach or suggest a packaging assembly as claimed and discussed above for an electronic device that allows the device to effectively operate at frequencies up to 50 GHz. Therefore, Applicant submits that Beigel fails to provide the teaching missing from Shenoy or Lau that would make Applicant's claimed invention obvious.

U.S. Patent Publication 2004/0099958 to Schildgen et al. discloses an interconnect module 100 that is configured to prevent cracks. It appears the Examiner is relying on Schildgen et al. to teach a cover for a packaging assembly. However, Schildgen et al. fails to provide the teachings missing from Shenoy as discussed above that would allow an electronic circuit to operate at frequencies up to 50 GHz.

U.S. Patent No. 5,223,624 issued to Heckaman et al. discloses a package for a microwaved circuit chip. It is believed the Examiner is relying on Heckaman et al. to teach an impedance matching compensation network, including a capacitive stub and an inductive stub. However, Heckaman et al. fails to teach or suggest an electronic device mounted to one side of a substrate, where the substrate is made of a laminate material including a fiber and resin mixture having a thickness less than 0.01", and where an opposite side of the substrate is mounted to a ball grid array. Therefore, Heckaman et al. fails to provide the teaching missing from Lau that would make Applicant's claimed invention obvious.

In view of the amendments and discussion above, it is respectfully requested that the §102(b) and §103(a) rejections be withdrawn.

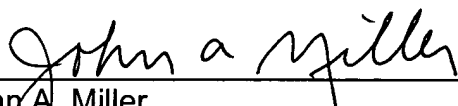
It is now believed that this application is in condition for allowance. If the Examiner believes that personal contact with Applicant's representative would expedite prosecution of this application, he is invited to call the undersigned at his convenience.

Respectfully submitted,

**WARN, HOFFMANN, MILLER  
& LaLONE, P.C.**

Attorneys for Applicant(s)

Date: 3/15/05

  
\_\_\_\_\_  
John A. Miller  
Registration No. 34,985

P.O. Box 70098  
Rochester Hills, MI 48307  
Telephone: (248) 364-4300  
Facsimile: (248) 364-4285